SECOND EDITION.

WILLATS'S

SCIENTIFIC MANUALS, No. I.

PLAIN DIRECTIONS

FOR OBTAINING

PHOTOGRAPHIC PICTURES

BY THE

CALOTYPE, ENERGIATYPE,

AND

OTHER PROCESSES ON PAPER;

INCLUDING THE

CHRYSOTYPE, CYANOTYPE, CHROMOTYPE,

ETC., ETC.

WITH ALL THE LATEST IMPROVEMENTS.

EDITED

BY JOHN H. CROUCHER.

LONDON:

T. & R. WILLATS, OPTICIANS, 98, CHEAPSIDE:

AND

SHERWOOD, GILBERT, & PIPER, PATERNOSTER-ROW;

AND ALL BOOKSELLERS.

(ENTERED AT STATIONER'S HALL.)

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THE favourable manner in which the first edition of this little Work has been received, and the rapidity with which a large impression has been exhausted, have determined the Publishers to reprint it, with such additions and modifications as will render it more generally acceptable. In addition to the instructions for the Calotype and Energiatype, which have been carefully revised, this Manual will contain Directions for conducting all the Photographic processes on paper, which can be of any use to amateurs. The demand for simple and concise treatises on many other branches of science and art, has further induced them to change the general title of the series; and the present Work will therefore appear as NUMBER ONE, OF WILLATS'S SCIENTIFIC MANUALS.

LONDON, 1*st June*, 1845.

PLAIN DIRECTIONS

FOR

OBTAINING PHOTOGRAPHIC PICTURES BY THE CALOTYPE, ENERGIATYPE, AND OTHER PROCESSES ON PAPER.

THE art of Photography, by which, through the agency of light, the most accurate and beautiful representations of objects are obtained, is the fruit of modern science and research. The darkening of nitrate of silver under the rays of the sun had indeed been long known, but no attempt was made to apply this fact to the purposes of art until 1802, when Mr. T. Wedgewood published a "Method of Copying Paintings upon Glass, and making Profiles by the Agency of Light upon Nitrate of Silver." That eminent chemist, Sir Humphrey Davy, assisted Mr. Wedgewood in his enquiries; but being unable to discover any mode of fixing the images obtained, the experiments were abandoned. About 1814, Mr. Niepce, of Chalons sur Marne, turned his attention to this subject; and in 1827, presented to the Royal Society of London some specimens of pictures produced by the agency of light on glass, copper plated with silver, and highly planished tin: soon after which he entered into partnership with M. Daguerre. The latter gentleman, after repeated, but it would seem fruitless attempts, to prepare a sensitive paper, entered upon those experiments which ended in the discovery of the beautiful process on silver plates which bears his name. In the interval, Mr. Henry Fox Talbot made known the results of his enquiries into the action of light upon salts of silver, in a paper read before the Royal Society in January, 1839, which he followed up in the succeeding month by another, detailing his method of preparing a paper for photographic purposes, and

fixing the designs. This paper was not, however, sufficiently sensitive to be used in the camera-obscura; but Mr. Talbot continuing his experiments, found means to increase the sensibility of his paper, and in 1841 patented the process, to which he has given the name of CALOTYPE, but which has recently (in accordance with the fashionable photographic nomenclature) been termed the TALBOTYPE. Many distinguished scientific men have lately devoted their attention to this subject; and various processes on paper have been from time to time announced by—Sir John Herschel, Mr. Robert Hunt, and others, under the names of AMPHITYPE, ANTHOTYPE, CHROMOTYPE, CHRYSOTYPE, CYANOTYPE, ENERGIATYPE, etc., etc. The first edition of this little work referred to the Calotype and Energiatype only; but we shall endeavour to render our present Manual more complete by such notices of the various processes just enumerated, as their particular merits may seem to require. The Daguerreotype, from its peculiarity and importance, demands a separate consideration, and is made the subject of a distinct number of the present series.* Avoiding, as far as possible, all scientific technicalities, we shall endeavour to give such concise and plain directions as will enable the amateur to obtain the most successful results. Those who may desire to learn something of the philosophical principles involved in the experiments brought under their notice in the subsequent pages, will do well to consult Mr. Robert Hunt's valuable Work, entitled, "Researches on Light," published in the course of the last year.

Before entering on the various processes we are about to describe, we shall briefly notice the apparatus which the amateur will require, in performing this class of photographic operations. Where camera pictures are not desired, it will be simple and inexpensive.

Some camel's-hair brushes, a quire or two of good writing paper, and a few sheets of blotting paper are indispensable. The brushes should be large, the hair collected together in one pencil, and must be, by no means, bound in tin. A separate brush is required for each solution, which should be carefully washed after using. The paper should be carefully selected: to a want of sufficient caution in this respect, must be attributed the constant failures of many experimenters. Whatman's or Turner's superfine yellow or blue wove, is generally recommended, but Moinier's pure white

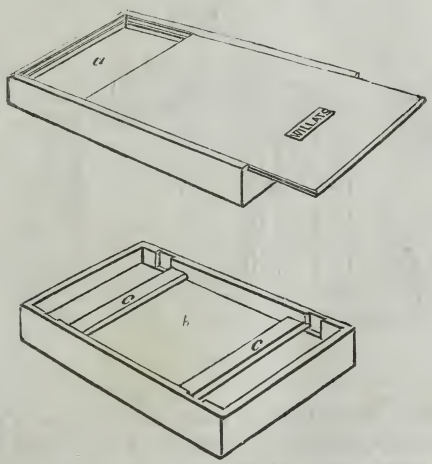
* Photographic Manuals, No. 2. Practical Hints on the Daguerreotype. T. & R. Willats, 98, Cheapside, London.

paper is decidedly the best we have met with. Every sheet should be examined by a strong light, and all those rejected which have any spot upon them, as also those which are found on trial to imbibe the solutions unequally. One side of the sheet should have a pencil mark upon it, by which it may be recognised. The blotting-paper must be the white wove, and the sheets used in different stages of the process should be kept separate. A trough of Berlin Ware, which is not acted upon by chemical preparations, and a slab of the same material are also required for preparing and washing paper.

Copying Frame.

All that is absolutely essential for this purpose, is a piece of plate glass of a sufficient size, and a board of similar dimensions covered with soft flannel: these, with the prepared paper and object to be copied placed between them, may be kept in contact by three or four binding screws. But the most convenient apparatus is represented at Fig. 1, consisting of a frame in which a piece of plate

Fig. 1.



glass (*a*) is fixed, with a wooden back covered with a cushion of flannel. The back may be removed to admit of the introduction of

the paper and object, and when replaced, may be pressed evenly and firmly against the glass by screws (*cc*) placed at the back. A sliding top covering the glass excludes the light, until it is desired to submit the paper to the action of light, or to protect it from change if kept for a short period without setting.

Camera Obscura.

The Camera Obscura adapted for photographic purposes, is a very superior instrument to that commonly sold under the name. The lens may be either achromatic or miniscus.

Willats's Improved Camera, (Fig. 2,)

Which may be used for any photographic purpose, is a box, in the front of which the lens is bedded, by which an increase of light is obtained, the quantity admitted being regulated by a diaphragm, having apertures of different diameter. The back part

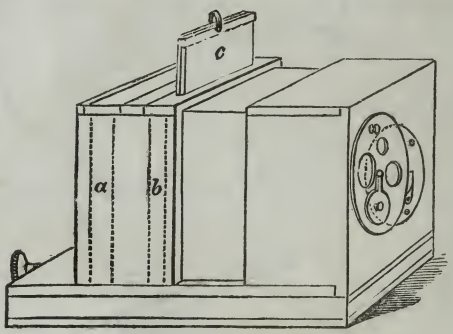


Fig. 2.

of the camera slides into the front, and to secure a very accurate adjustment, is mounted with a screw. It is moved in or out by turning a small handle at the back. The frame with the ground glass (Fig. 3) is furnished with a moveable top and sides, which when extended, exclude the light, and aid the operator in determining the best focus.

The second frame (Fig. 4) consists of a box (*b*), which, when the camera is applied to processes on paper, is made to receive

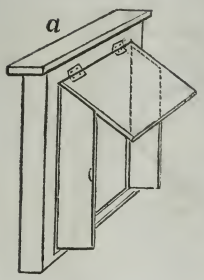


Fig. 3.

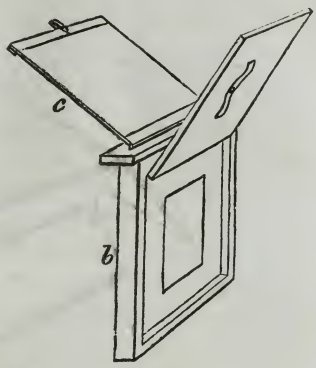


Fig. 4.

a piece of slate, iron, or glass, which is held tight by a spring at the back: this frame is furnished with a sliding door (*c*), laying over the top of the camera when raised. A picture four-inches square may be taken in this camera. The lens is usually $1\frac{3}{4}$ inch in diameter, and from eight to twelve inches focus.

A Camera more especially adapted to the Calotype process, is now constructed on a plan recommended by Mr. Cundell, whose contributions to the art are very valuable. Two miniscus lenses, each about three inches in diameter, and twenty-four inches in focus, are mounted in a sliding tube, their conjugate foci being as that of a single lens of thirteen inches. These, with an aperture of about 1—3 inch, and with one or more stops behind the lenses, give a picture beautifully defined. The focus is adjusted, and the prepared paper exposed much on the same principle as the other camera above described.

The Camera represented Fig. 5 (next page), is a new and very useful article, being made to fold up into the compass of a moderate

sized book, and may be carried in the pocket without inconvenience.

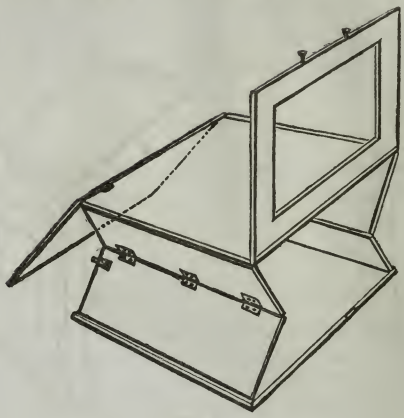


Fig. 5.

It is so arranged as to put together with the utmost ease, and is kept securely in its place by a bolt or two in the sides and back.

The Tripod Staff, (Fig. 6,)

Upon which the camera may be rested when no other suitable

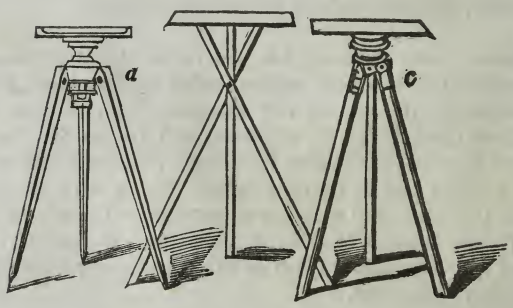


Fig. 6.

place can be found, is a very necessary auxiliary in taking views.

It is about four-feet six-inches high, and carries a small table on which the camera is placed. There are several varieties, differing in their construction and price.

Chemicals.

These should be all of the best quality, and should only be purchased of respectable parties who will guarantee their purity. Cheap chemicals are seldom economical, as the adulteration of any of them will interfere most annoyingly with the successful prosecution of the experiment. The following list comprises almost every article required in the processes hereafter described.

* Nitrate Silver in chrystals
Iodide Potassium
Bromide Potassium
Hyposulphite Soda
Pure Gallic Acid
„ Succinic Acid
Proto-sulphate Iron
Ammonia-citrate Iron
Ferro-sesquicyanuret Potassium
Yellow Ferro-cyanate of Potash
By-chromate Potash
Sulphate Copper
Nitric Acid
Strong Ammonia

THE CALOTYPE.

The Calotype, or Talbotype is, as we have already mentioned, the invention of Mr. Fox Talbot. It has been much improved since its first introduction; and to Mr. Cundell in particular we are indebted for many practical suggestions, which he first communicated to the world in the Philosophical Magazine.† In describing this process, we shall, without referring to authorities, give such simple directions for conducting it, as we have found from experience the most likely to produce satisfactory results.

* The Nitrate of Silver in solution is very easily affected by light, and should be kept in a dark place.

† No. 160, May 1844.

Preparation of the Iodized Paper.

Having selected paper of a close and even texture, and fine surface, such as that recommended p. 4, and marked it on one side with pencil, wash this side over carefully with a solution, consisting of 30 grains nitrate silver, dissolved in one ounce distilled water, which apply plentifully with a brush, thoroughly wetting every part, but leaving no moisture unabsorbed; this should be done on a hard smooth board, and thoroughly dried in the dark. Then take a solution of two hundred grains of iodide potassium in half-a-pint of water, to which fifty grains of salt have been added; draw the paper over the surface of the liquid, letting it repose upon it, when plastic, for a few seconds, never more than one minute. After dipping, drain it, and lay it flat until about half dry, then set it afloat in clean water for ten minutes, drawing it now and then along the surface: hang it in the air to dry, and when dry smooth it by pressure. It is of the utmost importance that all the soluble salts should be got out of the paper, and this is readily effected by leaving it floating for a time in water: a rougher washing would loosen the iodide of silver. This paper will keep some time if carefully laid by in a portfolio.

Application of the Gallo-Nitrate of Silver.

Dissolve fifty grains nitrate silver in two ounces of distilled water, to which add one-fifth of its volume of strong acetic acid, very pure. Dissolve also a small quantity of chrystalized *gallic acid* in distilled water, about eight grains to the ounce.* When about to use, mix one part of the latter solution with two parts of the former, mixing however only a sufficient quantity for immediate use, as the resulting liquid decomposes very rapidly. This, and indeed all the operations connected with the calotype, should be conducted in a room from which daylight is entirely excluded: it is indeed preferable to surround any artificial light, which may be used, with a screen of yellow glass, gauze, or paper, the rays which pass through materials of this colour, having little or no influence on the most sensitive preparations. The iodized paper may now be washed evenly over on the prepared side, which may

* A small quantity only of the gallic acid solution should be made at once, as it soon undergoes a change, becoming of a yellow colour, and unfit for use.

be recognised by its pale yellow colour, with the gallo-nitrate mixture, and must then be immediately transferred to clean blotting paper, and all the moisture carefully removed from the surface. A more even distribution of the gallo-nitrate solution may perhaps be obtained by pouring a little out on a slab, and passing the iodized paper over it, taking care that contact in every part is secured, and blotting as before. To save time, the gallic acid may be applied previously, and the paper kept thus half prepared.

Placing in the Camera.

Having prepared the iodized paper as directed above, in which state it is called calotype paper, it should be quickly transferred to the camera frame, enclosed between a plate of slate or iron, and a piece of plate glass to keep it smooth. If the slate or iron be gently warmed, the sensibility of the paper will be increased. The camera must now be put in the proper position, directed towards the object to be copied, and a good clear picture obtained on the ground glass. This picture, when an achromatic glass is used, will give a good working focus; but when the camera is fitted with a miniscus, or any other kind of non-achromatic lens, a peculiar adjustment is necessary to obtain what is called the chemical focus, which differs materially from the optical or visible focus. This chemical focus is about one thirty-sixth part shorter than the other, but the scale should be adjusted according to the lens and camera used. The frame, with the prepared paper, the shutter being perfectly closed, is now placed in the camera. The time of exposure here depends upon so many circumstances, the strength of the light, the colour of the object, the description of lens used in the camera, etc., etc., that it is impossible to give any practical rules upon the subject,—experience will be the best instructor. With a single achromatic lens in the morning sunshine, from thirty to sixty seconds is perhaps requisite for a building, and from one to two minutes for a portrait: in the shade from two to three minutes are required for either. Pictures are taken in a much shorter time, in from ten to twenty seconds, by using a combination of lenses, or with a single lens under very favourable circumstances. The best position for taking a building, is at a distance about twice the measure of its greatest dimension, and from an elevation of about one-third of its height. Where some parts of the building are nearer than others, place the focus to that part which it is most

desirable to have clear, and neglect the others. It is not advisable to take new and old buildings in the same picture, as the time necessary for the old will over-do the new. The sky is frequently overdone, which may be prevented by interposing a black-screen upon the glass over that part which corresponds to it, and which may be previously ascertained by reference to the ground-glass. Portraits should be taken in the open air, but not in the sun. The best uniform back-ground is a blanket, but figures may be grouped in front of a house, or a mass of foliage. There should not be too much white in the dress, as it will be solarized or blotched, before the other parts are distinctly pourtrayed.

Bringing Out the Impression.

When the paper is removed from the frame, always in the dark, nothing is visible; it must then be again washed over with the gallo-nitrate of silver, and exposed to a radiated heat from a gentle fire, or a bottle of hot water,* or to what is still better, a jet of steam, holding the paper vertically before it, never suffering the paper to become in any part perfectly dry. When the picture is, in the opinion of the operator, sufficiently distinct, it must be carefully washed in distilled or rain water, as warm as the finger can bear—the water being changed once or twice, and then dried in blotting-paper.

Fixing Process.

To fix the picture, soak it for two or three minutes, or longer if strongly developed, in a solution of half an ounce of hyposulphite soda to a pint of water, turning it occasionally, and then soak it in water from twelve to twenty-four hours, according to the thickness of the paper, and dry it. The sweetness of the hyposulphite of silver, which is readily communicated to any quantity of water, affords an excellent means of testing when the picture is freed from its influence. It should be washed until the water is perfectly tasteless.

The Calotype process is intended solely for the camera-obscura, and the pictures so obtained are all negative; that is, the lights and shadows are reversed. From these, however, any number of positive pictures, or pictures in which the lights are represented by

* A convenient apparatus for this purpose may be had of Messrs. T. & R. Willats.

lights, and the shades by shades, may be taken in the manner described under the next head.

Mr. Fox Talbot has recently published a method of removing the yellowish tint from pictures taken on calotype and other photographic papers prepared by nitrate of silver, by plunging the picture into a bath composed of hyposulphite of soda, dissolved in ten times its weight of water, and heated nearly to the boiling point. The picture should remain in it about ten minutes, and be then washed in warm water and dried. By this means, he says, the picture is rendered more permanent, and the lights whiter. He also recommends the following means for improving photographic pictures :—

"A copy or reversed impression of a photographic picture is taken in the ordinary manner, except that it remains in the light twice the usual time; its shadows are thus rendered too black, and its lights not sufficiently white. It is then washed and plunged into a bath of iodide of potassium (of the strength of five hundred grains to each pint of water) for one or two minutes, which makes the picture brighter, and its lights assume a pale yellow tint. After this it is washed, and immersed in a hot bath of hyposulphite of soda, until the pale yellow tint is removed, and the lights remain quite white. The pictures, thus finished, have a pleasing and peculiar effect of light and shade, which is not easily attainable by other means."

The transparency of calotype and other pictures may be increased by causing melted wax to penetrate the pores of the paper in the following manner. A small quantity of white wax is scraped on the back of the picture, it is then placed between two other papers, and a hot iron passed over it, which melts and spreads the wax. Or a little boiled oil may be spread over it, and the excess removed by bibulous paper. Canada balsam, or mastic varnish, with turpentine, are very good materials for the same purpose.

It may be necessary to remind the reader, that the CALOTYPE is a patented process. In the two patents obtained by Mr. Fox Talbot, the use of the following processes is claimed as his exclusive right. Some of these claims must, however, be considered invalid, and would possibly affect the value of the entire patents if brought to trial :—

The employment of gallic acid, or tincture of galls, in conjunction with solutions of silver, to render prepared paper more perfect. The obtaining portraits from life by photographic means upon

paper. The employing Bromides for fixing the images obtained. The transferring pictures from one sort of sensitive paper to another. The employment of boiling solutions of hyposulphites, to give increased whiteness to calotype and other photographic pictures; and the process of waxing, when the picture has been rendered more transparent by these means. The process of warming the paper, during the formation of the image, by placing a warm plate of iron behind it to increase the sensibility. The employment of iodized paper excited or rendered sensitive by a liquid, containing only a small portion of nitrate of silver, and subsequently dried; so as to preserve its sensitive state. The varying the lights and shadows of a picture by iodide of potassium, and the fixing the picture so changed. The placing a sheet of white or coloured paper behind photographic pictures after having waxed them. The obtaining enlarged portraits and pictures by throwing a magnified image thereof, by lenses, on photographic paper. The application of photography to printing, by arranging suitable letters or figures, so as to form pages, and making photographic images thereof. The system or combination of the following several photographic processes into one, whereby permanent and perfect copies of the positive kind are obtained, namely, the formation of the negative copy—the fixing it, so that it shall have the requisite transparency, and endure great subsequent exposure to the light—the formation of the positive from the negative copy, and its permanent fixation.

Positive Pictures.

Many attempts have been made to produce positive calotype pictures by a single process, but the methods proposed are all difficult of execution, and rarely successful. The following plan was introduced by Professor Grove, at the last meeting of the British Association held at York. Ordinary calotype paper is darkened until it assumes a deep brown colour, almost amounting to black; it is then re-dipped into the ordinary solution of iodide of potassium and dried. When required for use, it is drawn over dilute nitric acid, one part acid to two-and-a-half parts water. In this state, those parts exposed to the light are rapidly bleached, while the parts not exposed remain unchanged. It is fixed in the usual method. Mr. Grove brought forward, on the same occasion, another process, by which, a negative calotype was converted into a positive one. An ordinary calotype picture is to be taken in the

camera and developed by gallic acid, then drawn over iodide of potassium, and dilute nitric acid, and exposed to full sunshine: while bleaching the dark parts, the light is re-darkening the newly precipitated iodide in the lighter portions, and thus the negative picture is converted into a positive one.

These processes are, as we have said, difficult to manage successfully; and the resulting pictures have, though more minutely defined, and free from many defects inherent to copies through paper, the same disadvantages as those of the Daguerreotype, viz. the positions are reversed, and the copies cannot be multiplied.

A good negative picture having been obtained and carefully set, copies may be procured on almost any kind of photographic paper. The following are the formulas for making the papers commonly used for the purpose. The Energiatype paper, which is also very suitable, is described further on.*

1. Mr. Fox Talbot's Photographic Paper.—Take a sheet of good paper, and having dipped it for a minute or so in a solution of common salt, one part of saturated solution to eight parts of water, dry it first in blotting paper, and then spontaneously. Wash one of the sides, previously marked, with a solution of nitrate of silver—eighty grains to one ounce of distilled water. Allow it to dry, and it is ready for use.

2. Mr. Cundell's Paper.—To a solution of one drachm of nitrate silver, in twelve drachms of water, add strong ammonia, till the precipitate which falls is just re-dissolved. Wash the marked side of the paper over with this solution, then dip it in water containing forty grains common salt to the pint; apply the nitrate of silver solution as before, and dry carefully in the dark.

3. Mr. Cooper's Paper.—Soak the paper for a few minutes in a boiling solution of chlorate of potash, (the strength is immaterial;) dry it, and wash it on one side with a solution of nitrate of silver, sixty grains to the ounce of distilled water. This paper is not very sensitive, but the image can be fixed by washing only.

4. M. Daguerre's Paper.—Immerse the paper in hydrochloric (muriatic) ether, which has become acid from keeping; the

* Iodized, Photographic, and Energiatype Paper, may be obtained of Messrs. T. & R. Willats, 98, Cheapside.

paper is then carefully and completely dried. It is then dipped into a solution of nitrate of silver, and dried without artificial heat in a perfectly dark room. This paper is very sensitive when quite new, but gradually loses its impressionability.

5. Bromide Paper.—Dissolve 100 grains bromide potassium in one ounce distilled water, and soak the paper in this solution. Take off the superfluous moisture, and when nearly dry, brush it over on one side only with a solution of 100 grains nitrate of silver, to one ounce water. This paper is readily prepared, and tolerably sensitive. If required to be very sensitive, it should be brushed over a second time with the nitrate of silver.

These papers really vary very little from each other, and we should recommend Nos. 1, 2, and 5. The same general rules must be observed in the preparation of each. They must all be dried in the dark after the nitrate of silver has been used. If the paper is brushed over, the brush must be large and broad, so that the whole of the sheet may be wetted in two or three sweeps, otherwise marks will appear in the paper corresponding to the lines made by the brush. If blotting paper is required, it must be frequently changed, and never used for two different preparations.

A sheet of either of the above papers may be taken and laid with the marked side upward, on a piece of board covered with flannel: on this paper must be laid the negative picture, with its face downwards, and over both a piece of plate glass, the glass and board being tightly pressed together by screws or weights. The frame described, page 7, is a most convenient apparatus for this purpose. It must now be exposed to light; in about ten or fifteen minutes of bright sunshine, or in several hours of common daylight, a beautiful positive picture is produced, in which the lights and shadows are corrected. These pictures have a fine effect, though they lose somewhat of their sharpness in passing through the copy. They may be set with hyposulphate of soda, as directed for the *negative* pictures. If the negatives are clear, and the shadows dark, a great many copies may be obtained from them.

We may mention here, that copies of Prints, Feathers, Lace, etc., are obtained in the same manner as the positive pictures just described; and where it is necessary to reverse them afterwards, as in the case of prints, the process must be gone through twice; that is, a strong negative picture must be first obtained, and then

positive copies must be got by printing from it. Beautifully accurate copies of a vast variety of objects may be procured in this way.

Some observations on this subject, which will be found under the head of ENERGIATYPE, will perhaps assist the operator.

ENERGIATYPE.

The process which Mr. Hunt has designated the Energiatype, is one of the simplest and most convenient modes of obtaining photographic pictures; and the public are much indebted to this gentleman for the prompt and handsome manner in which he communicated his discovery, through the pages of the 'Atheneum.'

"While pursuing," he says, "some investigations, with a view to determine the influence of the solar rays upon precipitation, I have been led to the discovery of a new photographic agent, which can be employed in the preparation of paper, with a facility which no other sensitive process possesses. Being desirous of affording all the information I possibly can to those who are anxious to avail themselves of the advantages offered by photography, I solicit a little space in your columns for the purpose of publishing the particulars of this new process. All the photographic processes with which we are at present acquainted, sufficiently sensitive for the fixation of the images of the camera obscura, require the most careful and precise manipulation; consequently, those who are not accustomed to the niceties of experimental pursuits, are frequently annoyed by failures. The following statements will at once shew the exceeding simplicity of the new discovery."

Here follows, in the original letter, the description of the process as then employed. We shall, however, introduce it to the amateur with such modifications as the experience of Mr. Hunt himself, and other gentlemen who have adopted the method, have suggested to us.

PREPARATION OF THE PAPER.—Good letter paper, Whatman's, or Moinier's pure white is best, is first washed over with the following solution, viz.; five grains succinic acid, dissolved in one fluid ounce water, to which is added about five grains common salt

and half a drachm mucilage gum arabic. When dry, the paper is drawn over the surface of a solution of sixty grains of nitrate silver in one ounce of distilled water. Allowed to dry in the dark, the paper is now fit for use, is of a pure white, retains its colour, and may be preserved for a considerable time in a portfolio, until wanted for use.

The preparation of this paper is by no means difficult, but requires much care and attention. The solutions must be applied very equally over the paper, which should be immediately hung upon a frame or clothes' horse to dry. Extreme care must be taken that the paper be not exposed to light, after the nitrate of silver solution has been applied, until required for use. Many of the disappointments experienced by the experimenters on the Energiatype are occasioned by a neglect of this precaution; as, although no apparent effect may have been produced by the exposure, the clearness of the subsequent picture will be seriously injured. The succinic acid must also be very pure. In the general way it will be found more convenient, and perhaps economical, to purchase the paper ready prepared. We shall now briefly describe the method of applying the Energiatype to the different purposes for which it is best adapted, premising that the varying circumstances of time, place, and light, will render necessary such modifications of the following directions as the experience of the operator may suggest. As a general rule, an open situation, sunshine, and, if possible, the morning sun should be preferred, as the image is sharper, and the colour produced more intense, and less effected by the subsequent fixing process.

NEGATIVE PICTURES.

In the Camera.—For a building, an exposure of half a minute in strong sunshine is usually sufficient; for a portrait, which can only be taken in the shade, two or three minutes is required. Directions for placing the camera, sitter, etc., etc. will be found under the Calotype process, at page 13.

Exact copies of prints, feathers, leaves, etc. may be taken, by exposing them to the light in the copying-frame, described, p. 7, until the margin of the prepared paper, which should be left uncovered, begins to turn very slightly. If the object to be copied be thick, the paper must be allowed to assume a darker tint, or the light will not have penetrated it.

Bringing Out the Picture.

When the paper is taken from the camera or the frame, nothing is visible upon it; but by attending to the following directions, the latent picture will quickly develop itself. Having mixed together about one drachm of a saturated solution of *protosulphate of iron* and two or three drachms *mucilage of gum arabic*, pour a small quantity into a flat dish. Pass the prepared side of the paper taken from the camera rapidly over this mixture, taking care to ensure complete contact in every part. If the paper has been sufficiently impressed, the picture will almost immediately appear, and the further action of the iron must be stopped by the application of a soft sponge and plenty of clean water. Should the image not appear immediately, or be imperfect in its details, the iron solution may be allowed to remain a short time; but it must be kept disturbed, by rapidly and lightly brushing it up, otherwise numerous black specks will form and destroy the photograph. Great care should be taken that the iron solution does not touch the back of the picture, which it will inevitably stain, and, the picture being a negative one, render useless as a copy. A slight degree of heat will assist the development of the image where the time of exposure has been too short.

The picture should be carefully washed to take off any superficial blackness, and may then be permanently fixed by being washed with water, to which a small quantity of ammonia, or, better still, hyposulphite of soda has been added. The paper must again be well soaked in clean water, to clear it from the soluble salts, and may then be dried and pressed.

POSITIVE PICTURES.

These are procured in the same manner as the copies of the prints, etc. just described; using the negatives before obtained in place of the objects themselves. Instead, however, of using the iron solution, the paper must be exposed to the light, in the frame, a sufficient time to obtain perfect copies. The progress of the picture may be observed by turning up the corner of the paper, and, if not sufficiently done, replacing it exactly in the same position. They should be fixed with hyposulphite as before directed. It is sometimes better to take negative pictures in the

same way, without using the iron; in which case, the following observations may be useful.

Feathers, if white, or of a light shade, will bear very little exposure; dark feathers may be left until the paper assumes a tolerably deep colour.

Lace.—White lace, net-work, etc. will not bear much exposure, and must be pressed very close to the paper; black lace, etc. may be exposed much longer.

Leaves, Flowers, etc.—These may be advantageously dried and pressed between blotting-paper for a short time before using. They require considerable exposure to produce a perfect copy of the veins and marks: in sunshine from fifteen to twenty minutes,—in ordinary day-light, for three or four hours. They are very beautiful when well executed, and may be coloured to imitate nature very closely.

Wings of Insects, etc.—These being in general very transparent, must not be exposed too long. When the body of the insect has been preserved by drying or dissecting, so as to be tolerably transparent, the following method will secure an accurate copy. Take a light image of the whole insect, and then comparing the copy and the original, cut out those parts which are less transparent than the others, and having placed the object on a fresh piece of prepared paper, cover it with the cut paper, so that the dark parts may be first exposed to light. When these are well delineated, remove the upper paper, and leave the whole exposed till every part is sufficiently pourtrayed. The same plan may be adopted for leaves and flowers, where the parts are of different thicknesses. In copying wreaths of oak or vine leaves, the stem may be replaced by paper cut to imitate it.

Etchings on Glass.—By covering a piece of glass with lamp-black and varnish, a subject may be traced on it with a point, which may be copied on the paper.

Pen and ink sketches on paper may be copied in the same manner.

"The advantage which this process possesses," says Mr. Hunt, "over every other, must be apparent. The papers are prepared in the most simple manner, and may be kept ready by the tourist until required for use: they require no preparation previously to their being placed in the camera, and they can be preserved until

a convenient opportunity offers for bringing out the picture, which is done in the most simple manner, with a material which can be anywhere procured.

It has been found by experiment, that the sulphate of iron has the property of developing the latent images on papers prepared with other salts of silver, and that by using the acetate bromide, benzoate, etc., the most varied and beautiful effects are elicited.

The calotype picture may, it is said, be developed in this way after an exposure of one or two seconds only.

CHRYSOTYPE.

Sir John Herschel, whose various experiments have done so much for the art of Photography, is the discoverer of this process, and that of the Cyanotype, of which we shall next speak. They are both founded upon the use of the salts of iron as photographic agents. The Chrysotype process was communicated to the Royal Society in June, 1843, and is as follows:—

Paper is washed over with a moderately concentrated solution of ammonia-citrate of iron, and dried,—the strength of the solution being such as to dry into a good yellow colour, and not at all brown. In this state it is ready to receive a photographic image, which may be impressed on it either from nature in the camera-obscura, or from an engraving in a frame in sunshine. The image so impressed, however, is faint, and sometimes hardly perceptible. The moment it is removed from the camera, it must be washed over with a neutral solution of gold, of such strength as to have the colour of sherry-wine. Instantly the picture appears; not indeed at once with its full intensity, but darkening rapidly up to a certain point. At this point nothing can surpass the sharpness and perfection of detail of the resulting photograph. The picture is now to be rinsed in spring water, which must be three times renewed. It is then blotted and dried, after which it is to be washed on both sides with a somewhat weak solution of hydriodate of potash. After being again rinsed and dried, it is now perfectly fixed. If the nitrate of silver be used instead of the solution of gold, the picture is brought out more slowly, and with much less beauty.

CYANOTYPE OR FERROTYPE.

This name has been given, by Sir John Herschel, to several processes in which cyanogen is used in combination with iron. The term Ferrotype, which is sometimes applied to them, may with more propriety designate the whole of those photographic processes, a numerous class, in which iron may be employed as the developing agent.

First Process.

The paper is washed over, as in the Chrysotype, with a solution of ammonia citrate of iron. It is now exposed to light, and a latent picture impressed upon it. If the paper has sensibly darkened, the picture will appear negative. It is now brushed over very sparingly and equally with a solution of the ferro-cyanate potash, in which is dissolved a little gum arabic. The negative picture quickly vanishes, and is more slowly replaced by a positive one of a violet blue colour, on a greenish yellow ground. If when dry the details are not sufficiently distinct, a second wash will generally bring out the picture, which should be beautiful and sharp.

Second Process.

A paper is prepared with a mixture of equal proportions of ammonia-citrate iron, and ferro-sesquicyanate of potash. When a picture has been impressed, it is thrown into water, and dried, and a negative picture results. If this picture is washed with a solution of the proto-nitrate mercury, it is readily discharged, but is susceptible of restoration by thoroughly washing out the mercurial salt, and drying the paper. A smooth iron, rather hot, but not sufficiently so to scorch the paper, is now passed over it, and the obliterated picture immediately re-appears, but of a brown tint. These photographs gradually fade and disappear, but may be again restored by the application of heat.

Third Process.

One part by weight of ammonia-citrate of iron is dissolved in eleven parts of water, and this is mixed with an equal quantity of

saturated cold solution of bichloride mercury. Before a precipitate has had time to form, the solution is brushed over paper, which should have a yellowish rather than a blueish cast, and dried. This paper keeps well, and when used is exposed to light, until a faint but perfectly visible picture is impressed. It is then brushed over as rapidly as possible with a saturated solution of prussiate of potash, diluted with three times its bulk of gum water, so strong as just to flow freely without adhesion to the lip of the vessel. The wash must be spread with one application, evenly and very quickly, over every part of the paper. It is fixed by drying. Beautiful positive pictures are thus produced, which will bear immediate exposure tolerably well, but which after a few days will bear strong sunshine uninjured. If the impression be overdone, the darker shades will disappear: if too little, the whole runs into blot. The exact time of exposure can only be learnt by practice.

There are several other varieties of these processes, which are not sufficiently important to be included here: the formula may be seen by reference to Sir John Herschel's Papers in the 'Philosophical Transactions.' The following process communicated by him to the British Association in 1843, is, however, so curious, that we are induced to insert it here. If nitrate of silver, specific gravity 1.200, be added to ferro-tartaric acid, specific gravity 1.023, a precipitate falls, which is in a great measure re-dissolved by a gentle heat, leaving a black sediment, which, being cleared by subsidence, a liquid of a pale yellow colour is obtained, in which a further addition of the nitrate causes no turbidness. When the total quantity of the nitrated solution added, amounts to about half the bulk of the ferro-tartaric acid, it is enough.

The liquid so prepared, does not alter by keeping in the dark. Spread on paper and exposed wet to sunshine (partly shaded) for a few seconds, no impression seems to have been made; but by degrees, although withdrawn from the light, it developes itself spontaneously, and at length becomes very intense. But if the paper be thoroughly dried in the dark (in which state it is of a very pale greenish yellow colour,) it possesses the singular property of receiving a dormant or invisible picture; to produce which (if it be for instance an engraving that is to be copied) from thirty seconds to a minute's exposure in the sunshine is requisite. It should not be continued too long, as not only is the ultimate effect less striking, but a picture begins to be *visibly* produced, which darkens spontaneously after it is withdrawn. But if the exposure be discon-

tinued before this effect comes on, an invisible impression is the result, to develope which all that is necessary is to breathe upon it, when it immediately appears, and very speedily acquires an extraordinary intensity and sharpness, as if by magic. Instead of the breath, it may be subjected to the regulated action of aqueous vapour, by laying it in a blotting-paper book, of which some of the outer leaves on both sides have been damped, or by holding it over warm water.

CHROMOTYPE.

M. Ponton was the first to point out the photographic properties of bichromate of potash. His process for preparing paper is as follows :—Immerse a well-sized paper in a saturated solution of bichromate potash, and dry by the fire. It is of a fine yellow colour, and keeps well in the dark. When exposed to the rays of the sun, it becomes of a light brown ; and if an engraving has been placed upon it, the resulting picture is negative. It is fixed by soaking in water. Mr. E. Becquerel improved upon this process by applying evenly over the paper a sizing of starch, and then steeping it in the bichromate solution as before. The picture having been taken, and the paper washed and dried, it is immersed in a weak alcoholic solution of iodine, in which it remains some time, and is then rinsed and carefully dried between blotting-paper, without much heat. When wet, the shades of the picture are of a fine blue ; but when dry, of a deep violet. If the picture, while wet, is covered with a coating of gum, the colour is better preserved and is more beautiful when dry.

Mr. Hunt announced the process, which is termed the Chromotype, at the meeting of the British Association in 1843. It is not sufficiently sensitive for the camera, but is valuable for copying engravings, etc. Good writing paper is washed over with sulphate of copper, in solution, about one drachm to an ounce of water ; when dry, it is again washed with a strong, but not saturated solution of the bichromate of potash, and again dried. The paper may be preserved in this state for a considerable time. When exposed to sunshine, it changes to a dull brown, and if checked here, a negative picture is produced ; but if the action of light is continued, the browning gives way, and the picture becomes posi-

tive,—yellow on a white ground. From five to twenty minutes is usually required to produce the effect. In either case, if the picture be washed over with a solution of nitrate of silver, a very beautiful positive picture results. To fix the picture, wash it immediately in pure water, and dry it. If the water contains any muriates, the picture suffers, and long soaking entirely destroys it. When a few grains of common salt are added to the water, a curious effect is produced. The picture is apparently rapidly destroyed, but may be restored by an exposure to the sun of from ten minutes to a quarter of an hour, and is now of a lilac colour,—the shades depending on the quantity of salt used. No fresh process is required to fix it.

A beautiful variety of the Chromotype is thus described by Mr. Hunt. "A neutral solution of the chloride of gold is mixed with an equal quantity of the bichromate of potash. Paper is washed with this solution, and dried near the fire. On exposing this paper to light, it speedily changes, first to a deep brown, and ultimately to a blueish black. If an engraving is superposed, we have a negative copy, blue or brown, upon a yellow ground. If this photograph is placed in clean water, and allowed to remain in it for some hours, very singular changes take place. The yellow salt is all dissolved out, and those parts of the paper left beautifully white. All the dark portions of the paper become more decided in their character, and accordingly as the solarization has been prolonged or otherwise, or the light has been more or less intense, we have either *crimson, blue, brown, or deep black photographs of a most beautiful character.*" *

AMPHITYPE.

This is another of the interesting and valuable discoveries of Sir John Herschel. It was given to the public at the last meeting of the British Association, and is described by him as follows:—

Paper, proper for producing an amphitype picture, may be prepared, either with the ferro-tartrate or the ferro-citrate of the protoxide or the peroxide of mercury, or of the protoxide of lead; by using creams of these salts, or by successive applications of the nitrates of the respective oxides, singly or in mixture, to the

* Researches on Light, by Robert Hunt, 1844.

paper, alternating with solutions of the ammonio-tartrate or ammonio-citrate of iron,* the latter solutions being last applied, and in more or less excess. I purposely avoid stating proportions, as I have not yet been able to fix upon any which certainly succeed. Paper so prepared and dried takes a negative picture, in a time varying from half an hour to five or six hours, according to the intensity of the light; and the impression produced varies in apparent force from a faint and hardly perceptible picture, to one of the highest conceivable fulness and richness, both of tint and detail, the colour in this case being a superb velvety brown. This extreme richness of effect is not produced except lead be present, either in the ingredients used, or *in the paper itself*. It is not, as I originally supposed, due to the presence of free tartaric acid. The pictures in this state are not permanent. They fade in the dark, though with very different degrees of rapidity, some (especially if free tartaric or citric acid be present) in a few days, while others remain some weeks unimpaired, and require whole years for their total obliteration. But though entirely faded out in appearance, the picture is only rendered dormant, and may be restored, changing its character from negative to positive, and its colour from brown to black (in the shadows) by the following process :—A bath being prepared by pouring a small quantity of solution of pernitrate of mercury into a large quantity of water, and letting the sub-nitrated precipitate subside, the picture must be immersed in it, (carefully and repeatedly clearing off all air bubbles,) and allowed to remain till the picture (if anywhere visible) is entirely destroyed, or if faded, till it is judged sufficient from previous experience; a term which is often marked by the appearance of a feeble positive picture, of a bright yellow hue, on the pale yellow ground of the paper. A long time (several weeks) is often required for this, but heat accelerates the action, and it is often complete in a few hours. In this state the picture is to be very thoroughly rinsed and soaked in pure warm water, and then dried. It is then to be well ironed with a smooth iron, heated so as barely not to injure the paper; placing it, for better security against scorching, between smooth clean papers. If then the process has been successful, a perfectly black positive picture

* So commonly called, and sold as such; but as I am disposed to regard their composition, their chemical names would be ferro-tartrate and ferro-citrate of ammonia.

is at once developed. At first it most commonly happens that the whole picture is sooty or dingy to such a degree that it is condemned as spoiled; but on keeping it between the leaves of a book, especially in a moist atmosphere, by extremely slow degrees this dinginess disappears, and the picture disengages itself with continually increasing sharpness and clearness, and acquires the exact effect of a copper-plate engraving on a paper more or less tinted with pale yellow. I ought to observe, that the best and most uniform specimens which I have procured, have been on paper previously washed with certain preparations of uric acid, which is a very remarkable and powerful photographic element. The intensity of the original negative picture is no criterion of what may be expected in the positive. It is from the production, by one and the same action of the light, of either a positive or a negative picture, according to the subsequent manipulations, that I have designated the process thus generally sketched out, by the term *amphitype*,—a name suggested by Mr. Talbot, to whom I communicated this singular result; and to this process, or class of processes, (which I cannot doubt when pursued will lead to some very beautiful results,) I propose to restrict the name in question, though it applies even more appropriately to the following exceedingly curious and remarkable one, in which silver is concerned. At the last meeting I announced a mode of producing, by means of a solution of silver, in conjunction with ferro-tartaric acid, a dormant picture brought out into a forcible negative impression by the breath or moist air. The solution then described, and which had, at that time, been prepared some weeks, I may here incidentally remark, has retained its limpidity and photographic properties quite unimpaired during the whole year since elapsed, and is now as sensitive as ever,—a property of no small value. Now, when a picture (for example an impression from an engraving) is taken on paper washed with this solution, it shows no sign of a picture on its back, whether that on its face be developed or not; but if, while the actinic influence is still fresh upon the face, (*i. e.* as soon as it is removed from the light,) *the back* be exposed for a very few seconds to the sunshine, and then removed to a gloomy place, a *positive picture*, *the exact complement of the negative one on the other side*, though wanting of course in sharpness if the paper be thick, *slowly and gradually makes its appearance* there, and in half an hour or an hour acquires a considerable intensity. I ought to mention that the "Ferro-tartaric acid" in question is prepared by precipitating the ferro-tar-

trate of ammonia (ammonio-tartrate of iron) by acetate of lead, and decomposing the precipitate by dilute sulphuric acid.

P. S. When lead is used in the preparation of Amphitype paper, the parts on which the light has acted are found to be in a very high degree *rendered water proof.*

ANTHOTYPE.

The influence of light upon the growth and germination of plants is very curious and interesting. The facts connected with this subject have been investigated by Mr. Chevrieul, Mr. Hunt, and Sir John Herschel. To the latter gentleman we are indebted for the enquiries which have led to the publication of the Anthotype process. He found that the expressed juices, and alcoholic or watery infusions of certain flowers, more particularly the papaver rhœas, the coschoous taponica, the violet rose, ten weeks' stock, etc. etc. when spread on paper, were very sensitive to light. To procure this colouring matter, the petals of fresh and well-selected flowers are bruised to a pulp in a marble mortar, either alone or with the addition of a small quantity of alcohol,—the juice is expressed by squeezing the pulp through a piece of fine linen. The paper is prepared in the following manner:—"The paper should be moistened on the back by sponging and blotting off. It should then be penned on a board, the moist side downwards, so that two of its edges (suppose the right hand and lower one) shall project a little beyond those of the board. The board being then inclined twenty or thirty degrees to the horizon, the alcoholic tincture (mixed with a very little water, if the petals themselves be not very juicy) is to be applied with a brush, in strokes from left to right, taking care *not to go* over the edges which rest on the board, but to pass clearly over those that project; and observing also to carry the tint from below upwards by quick sweeping strokes, leaving no dry spaces between them, but keeping up a continuity of wet spaces. When all is wet, cross them by another set of strokes from above downwards, so managing the brush as to leave no floating liquid on the paper. It must then be dried as quickly as possible over a stove, or in a current of warm air, avoiding however such heat as may injure the tint." If

alcohol has not been added, the extract must be applied to the paper immediately. Most of the papers so prepared require an exposure of many days, from twenty to thirty, to produce a decided effect, and the pictures obtained are not always permanent. This will of course preclude their being of practical utility; but the changes produced are so remarkable, that we could not, with propriety, omit mentioning them. A full account of Sir John Herschel's experiments will be found in his Memoir, or "The Action of the Rays of the Solar Spectrum on Vegetable Colours," etc. published in the second part of the Philosophical Transactions for 1842.

Similar effects are produced by light in the gums resins and residua of essential oils, when thin films are spread upon paper or on metal plates. A paper prepared with an alcoholic solution of guaiacum, and placed in an aqueous solution of chlorine, acquires a beautiful blue colour; it is very sensitive, and may be used for copying engravings, the resulting picture penetrating the paper, and appearing on the back with almost the same intensity as on the face. The images, however, speedily fade.

In the preceding pages we have endeavoured to include all the Photographic processes which will be really useful to amateurs. There are many varieties of all these; every successful practitioner having his favourite formula, or modus operandi. To record all those that have been announced to the world, during the last two or three years, would require a volume, and would confuse rather than direct. We would recommend our readers to acquire a practical acquaintance with such as have been described; and then, if they have some chemical knowledge, a small portion of time devoted to the consideration of the general principles upon which they are all conducted, will possibly enable them to introduce divers modifications and improvements. We have already pointed the way to such enquiries, in referring to Sir John Herschel's papers in the Philosophical Transactions, and to Mr. Robert Hunt's Researches on Light, which, with a few papers scattered through some of our scientific periodicals, comprise everything of importance that has been written on the subject.

WILLATS'S ENERGETIC FLUID,

FOR PRODUCING INSTANTANEOUS PICTURES WITHOUT THE AID OF IODINE OR BROMINE.

THIS Fluid, perhaps the most active of the various preparations ever offered to the public as accelerating agents, is used as a single solution; and with due precaution in polishing the plate, and observing the colours, is almost invariable in its results. The mixture, consisting of 1½ drachms of the fluid in 2 ounces water, should be poured into a shallow trough to about a quarter inch of the top. The plate will generally assume the proper colour in from four to six minutes; if not, the mixture is too weak, and more of the fluid must be added. The brown, or deep rose colour gives the most rapid picture, and the blue the softest; intermediate tints should be carefully avoided. With a double lens, a portrait or view may be taken instantaneously in the sun, or in from one to five seconds in the shade, according to the degree of light. With a single lens, it will require one second in the sun, and from five to ten seconds in the shade. A longer exposure will only injure the strength and beauty of the picture. It is not generally understood that a sensitive plate, exposed to the action of light in the camera, is rapidly impressed with a picture, which strengthens up to a certain point, when it begins to fade, and is almost entirely effaced, when a negative picture forms, and at length becomes permanent. These changes have not yet been accurately observed, but there is reason to believe that the process alluded to is gone through several times in one minute. This fact, which may be easily proved by experiment, may account for the failures which some persons have experienced in using the Energetic Fluid. Having exposed the plate too long, until the picture has passed the proper stage, and commenced to darken, they conclude that it has not been sufficiently exposed, and acting under this erroneous impression, they increase the time, until every proof becoming worse than the preceding, the use of the Fluid is abandoned.

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Willats's Improved Photographic Camera, with Best Achromatic Lens 1¾ in. diameter, mounted in Brass Front, with variable diaphragm, fine screw adjustment Frame, with ground glass disc, and folding shutters, for obtaining the focus, shifting frame adapted for taking three various sized pictures, either by the Daguerreotype or Calotype processes..... 3 10 0

Ditto Ditto with compound set of achromatic Lens..... 6 6 0

This apparatus has the advantage of serving with all sorts of object glasses, whether simple or compound, and for all sizes of plates: its construction is very simple, and not likely to get out of order.

"PHOTOGRAPHY.—A Camera on an improved principle, for taking photographic portraits and views, has been invented by Mr. Willats, 98, Cheapside, which, upon examination, will be found much superior to that in ordinary use. We have heard many complaints of the common camera, the insufficiencies of which we think Mr. Willats is in a fair way to remedy. The camera invented by him is of superior value, inasmuch as it can be adjusted with much greater facility and certainty; and so obviates, in a great degree, the trouble often occasioned by the old instrument. We have examined some of the pictures executed by means of the improved camera, and find them most perfect, even to the minutest detail."—*Art Union, August*, 1844.

Willats's Improved Photographic Camera, packed in case, complete with every requisite, to enable the Tourist to take correct sketches from the varied and beautiful scenes in nature, and also well adapted for delineating portraits with the greatest accuracy, consisting of Mercury, Plate and Chemical Boxes, (which contains a full supply of the necessary preparations) Iodizing and Bromine Pans, Polishing Block and Velvet Buffs, Washing Tray and Stand, Brass Stand with adjusting screws, Spirit Lamp, Etna, prepared cotton wool, with Directions	10	10	0
Ditto Ditto with double combination of achromatic lenses	14	0	0
Small Photographic Cameras, with sliding tube, and Periscopic or Plano convex lenses, adapted either for the Daguerreotype, Calotype, or Energiatype processes	1	1	0
Do. Do. with Achromatic Lens	1	5	0
„ with rackwork adjustment	1	15	0
„ with calotype chemicals and apparatus	2	10	0
„ with Daguerreotype apparatus and materials, complete in case	5	5	0
Second size do. with achromatic lens, and sliding tube	1	15	0
„ „ with rackwork adjustment	2	2	0
„ „ with calotype chemicals and apparatus	3	16	0
„ „ with Daguerreotype apparatus, and materials complete in case	6	10	0
Photographic Camera, with best compound achromatic lens $1\frac{3}{4}$ in. diameter	5	10	0
Ditto ditto, complete in case, with every requisite for obtaining Daguerreotype pictures $2\frac{3}{4}$ by $3\frac{1}{4}$	10	0	0
Ditto, ditto, with best compound lens, 2 in diameter	6	6	0
Ditto, ditto, complete with additional apparatus, chemicals, &c. for obtaining pictures by the Daguerreotype processes, from $2\frac{1}{2}$ by 2 to 4 by 3 inches	14	14	0
Portable Folding Camera, with achromatic lens, rackwork adjustment, &c. from	4	4	0

This form of Camera is exceedingly convenient, being made to fold up into the compass of a moderate size book, and may be carried in the pocket without inconvenience.

Lerebour's Parisian Apparatus, with the latest improvements from	5	15	0
Cundell's Photographic Cameras, as described in the Philosophical Magazine, with double miniscus lenses	3	3	0

Voitglander's Double Combination of Achromatic Lenses, 3 in. diameter, mounted in brass cells, and tube with rack-work adjustment			20	0 0
Ditto	Ditto	2 inches diameter	10	10 0
Ditto	Ditto	1⅞ — diameter	6	6 0
Double Combination of achromatic lenses of very superior English manufacture, of corresponding curvature to Voitglander's, mounted in brass front, with rack-work adjustment, 4 in. diameter			15	15 0
Ditto	Ditto	3 in. diameter	10	10 0
Ditto	Ditto	2 in. diameter	4	4 0
Ditto	Ditto	1¾ in. diameter	3	10 0

The advantage gained by using the double combination of achromatic lenses over the single arrangement is, that they are far more rapid in their operation, and give a much sharper picture.

Achromatic lenses, 1 inch diameter, 4 inch focus, and upwards			0	6 0
Do.	1 inch diameter, 5 inch focus,		0	8 0
Do.	1 „ 6 „		0	10 6
Do.	2 „ 6 „		0	14 0
Parallel Mirrors mounted in brass frames, to attach to the front of the Camera, for reversing the pictures,			1	1 0
Prisms for Ditto	Ditto.			

Plano Convex, Periscopic, Miniscus, and every description of Lens required in Photographic Experiments.

Brass Camera Fronts, with rackwork adjustment for Lenses,—1 inch, 1¼ inch, 1½ inch, 1¾ inch, and 2 inch. Prices,—11s. 12s. 14s. 15s. ..... to			0	18 0
Brass Camera Fronts, with sliding tube for 1-inch lens .			0	6 0
Ditto	1¼-inch lens		0	7 0
Ditto	1½-inch lens		0	9 0
Ditto	1-inch lens		0	10 0
Ditto	2-inch lens		0	12 0
Brass Camera Fronts, with revolving diaphragm, on which are apertures of different diameters for regulating the intensity of the light, according to the nature of the picture, 1¼ in.			0	7 0
Ditto	Ditto	1½ in.	0	9 0
Ditto	Ditto	1¾ in.	0	10 6
Ditto	Ditto	2 in.	0	15 0
Mercury Boxes for small Cameras			0	13 0
Ditto	Ditto. 15s.		0	18 0
Ditto	Ditto best construction, with cast iron			

cistern, sliding front and legs, and coloured glass windows for viewing the development of the picture	1	4	0
Ditto Ditto with Thermometer, ... from	1	11	0
Plate Boxes to contain a supply of plates in mahogany or walnut wood.			
Ditto for 2½ × 2 in plates.....	0	4	0
Ditto for 3¼ × 2¾ „	0	5	0
Ditto for 4 × 3 „	0	5	6
Ditto in Japanned Metal.			
Ditto for 2 ^ 2 in. plates.....	0	1	9
Ditto for ?¼ ^ 2¾ „	0	2	6
Ditto for 4 × 3 „	0	3	0
Iodizing and Bromine Pans made of hard glazed porcelain, with air-tight slate covers ..... each	0	2	0
Ditto Ditto in mahogany or walnut cases, with three frames for holding the various sized plates	0	10	0
Ditto, with levelling screws and plate-glass covers ..from	1	1	0
Dark Coloured Glasses for the Bromine Solutions, or Chloride of Iodine ..... from	0	4	0
Iodine Boxes of various constructions. .....from	0	5	0
Earthenware Washing Tray and Stand.....	0	3	6
Do. in Copper and Glass ....from	0	2	6
Prepared Velvet Buffs for polishing, each 1s. 9d. ....to	0	2	6
Polishing Block for holding the plates during the polishing process	0	3	6
Plate Holders .....from	0	1	6
Glass Spirit Lamps .....each 2s. 3s. and	0	4	0
Brass Ditto. ....each	0	3	6
Brass Stands for supporting plates, ...2s. 6d. 3s. 6d. to	0	5	0
Ditto. with levelling screws..... from	0	5	6
Folding Tripod Staff, with brass mountings, and ball, and socket-joints, and screw-plate to attach to Camera, ...	1	5	0
Portable Folding Tripod Stand, with table to fix on top .....from £1 1s. to	1	15	0
Common Do. Do. .. 9s. 6d to	0	16	0
French Pattern Double Folding Tripod Stand, with table, etc.	2	2	0
This Instrument is exceedingly firm and steady.			
Glasses to indicate from five seconds to one minute, in Leather case.....each	0	2	6
Porcelain Slabs.....from	0	1	6
Red, Yellow, and Blue Glass.			
Finely Carded Cotton Wool .....per ounce	0	0	4
Apparatus for the Preparation of Chlorine Gas.....	0	2	6
Tin Stills, with worm and tub complete ....from	1	1	0
Copper do. of all sizes .... from	2	2	0
Retorts and Retort Stands, Receivers, Flasks, etc. etc.			
Graduated Glass Syringes for dosing the Bromine..	0	2	0

Claudets, Brass Frames, for retaining prepared plates each ..... 10d., 1s. and	0	1	2
Improved ditto, of Japanned Tin, with covers.....	0	2	0
Prepared Gold Beater's skin, for fastening pictures in frames.			
Pressure Frame and glass, for obtaining positive Photographs, or copying Engravings, Lace, Leaves, etc. etc. ..... from	0	5	0
Ditto Ditto with sliding lid ..... from	0	7	6
Portable Rectangular Frame, for preparing the Sensitive Paper	0	2	0
Ditto ditto	0	5	0
Earthenware Trays for washing and setting pictures	0	2	0
Camel's Hair Brushes, ... 1s., 2s.	0	2	6
Tin Vessels for heating Calotope drawings, ...3s. and	0	5	0
Photogenic Paper, in packets .....1s. and	0	2	6
Iodized Paper, in packets .....1s. and	0	2	6
Energiatype Paper, in packets .....1s. and	0	2	6
White Wove Blotting Paper .....per quire	0	1	6
Paper by Whatman, Turner, and other makers, of superior quality for Calotype purposes, per quire ..from	0	1	6
Moinier's Pure White Paper...	0	1	6
Glass Graduated Measures, ... 1s. 6d., 2s., and	0	2	6
„ Mortars and Pestles	0	2	6
„ Stirring Rods .....from	0	0	3
„ Funnels .....from	0	0	6
Brass Spirit Lamp, with sliding rings ..... .from	0	5	0
Scales and Weights, with glass Pans	0	18	0

Patent Plate Glass, for preserving pictures from dust or air, cut to any dimensions.

Silvered Plates warranted of the best English manufacture—

$2\frac{1}{2}$ inches by 2 inches.....per doz.	0	12	0
$3\frac{1}{4}$ „ $2\frac{3}{4}$ „ ..... „	0	18	0
4 „ 3 „ ..... „	1	7	0
5 „ 4 „ ..... „			
Do do French or German, $3\frac{1}{4}$ by $2\frac{1}{2}$..per doz.	0	12	0
Do. do. do. 4 by 3 „	0	18	0

If less than a dozen are taken, the prices will be rather higher.

Skeleton Frames to contain Daguerreotype Pictures—

Common do. with black line border on paper, for plates, $2\frac{1}{2}$ by 2.....8d. to	0	1	0
Do. do. $3\frac{1}{4}$ by $2\frac{3}{8}$ .....9d. to	0	1	0
Do. do. 4 by 3 .....1s. to	0	1	4
Do. painted on glass with black line border for plates, $2\frac{1}{2}$ by 2 .....10d. to	0	1	2

Common do. painted on glass with black line border for plates, 3¼ by 2¾ ..... 1s. to	0	1	3
Do. do. 4 by 3 .....1s. 3d. to	0	1	9
Best do. with ornamental gilt borders of various forms and patterns, for plates..... 2½ by 2, 1s 4d. to	0	1	8
Do. do. 3¼ by 2½ .....1s. 6d. to	0	1	9
Do. do. 4 by 3 .....1s. 9d. to	0	2	6
Leather Cases, with oval, square, or dome top, gilt mats and glasses complete, for portraits .. ..2 by 2½	0	2	0
Do. do ..... 3¼ by 2¾	0	3	0
Do. do. ..... 4 by 3	0	5	0
Ornamental Lacquered Brass Frames, in imitation of carved wood .....2s., 3s. 6d., and	0	4	0
Papier Machee Miniature Frames, with oval or square sights .....from	0	3	6
Improved Head Rests, ...from	0	7	6

Prepared Colours for colouring Daguerreotypes.

CHEMICAL PREPARATIONS.

Willats's Energetic Fluid, for producing instantaneous pictures without the use of iodine or bromine solutions.....per bottle	0	5	0
Iodine.....per oz.			
Do. pure ..... „			
Do. Tincture..... „			
Do. Chloride..... „			
Do. Bromide..... „			
Bromine, pure ..... „	0	4	6
Distilled Mercury ..... per lb.			
Hyposulphite Soda .....per oz.	0	0	6
Chloride Gold Solution ..... 2s. 6d. and „	0	5	0
Chloride Gold Chryst. .....per grain	0	0	3
Nitric acid, pure ..... per oz.	0	0	4
Prepared Tripoli ..... „	0	0	6
——— Rouge ..... „	0	0	6
——— Emery ..... „	0	0	6
——— Lamp Black..... „	0	1	0
Rulman's Sensitive Solution .....per bottle	0	2	6
Hyposulphite Gold Solution ..... per oz	0	0	3
Hyposulphite Gold Chryst ..... per grain	0	0	3
Improved Solution of Gold for fixing Daguerreotype Images .....per bottle	0	1	6
Pure Gallic Acid ....per oz.	0	10	0

Pure Succinic Acid	„	0	10	0
Glacial Acetic Acid	per oz.	0	1	6
Bromide Potassium	„	0	5	0
Pure Chloride Lime	„	0	0	6
Strong Solution Ammonia	„	0	0	4
Proto Sulphate Iron	„	0	0	4
Gum Arabic	„	0	0	6
Oil of Cloves	„	0	4	0
„ of Cassia	„	0	5	0
„ of Lavender	„			
Hyposulphite Soda	„	0	0	6
Pure Cyanide Potassium	1s. or „	0	2	0
Iodide Potassium	„	0	3	0
Chloride Potassa	„	0	0	6
Herschel's Solution of Ferro-tartrate Silver	per oz.	0	4	0
Distilled Water	per gall.	0	1	0

And every other Chemical Preparation required in practising the Photogenic Art.

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Apparatus for exhibiting the Dissolving Views as shown at the Royal Polytechnic Institution, with the Hydro-Oxygen Light; or on a smaller scale, suitable for Private use, Schools, &c. Illuminated by Patent Argand Lamps, and constructed on the most improved Principles, by T. & R. WILLATS, Opticians, 98, Cheapside, London, who have on hand a large Collection of

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